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F O R E W O R D

From time to time, interesting and valuable views and comments are being received from subscribers throughout the world. Such communications are much appreciated. It is hoped that many more subscribers will send in their news and views, as these would assist in making the Bulletin a more useful and representative publication.

In this connection, it might be mentioned that, due to postal irregularities, some letters and Bulletins have gone astray. Subscribers are urged to advise this office if they do not receive a prompt reply to their communications so that any inconvenience caused to them may be minimised.

December, 1953.

R E V I E W

AUSTRALIA, the Commonwealth country reviewed in this Bulletin, lacks deposits of native sulphur, but possesses substantial reserves of sulphur in other forms, notably sulphide ores and gypsum. Whereas the last-named source is not at present being exploited for its sulphur content, smelter gases and by-product pyrites, boosted under the Government conversion plan, are making very substantial contributions to the industry's sulphur needs. Sulphur production in 1952 amounted to about 200,000 tons, of which 60,000 tons was exported in the form of zinc concentrates, principally to the United Kingdom and to Belgium. The consumption was about 260,000 tons, the balance being supplied in the form of foreign brimstone which Australia obtains through the agency of the British Phosphate Commissioners, mainly from the United States, but also from Japan, Norway and Italy. Consumption is expected to reach 300,000 tons by 1955 and indigenous sulphur supplies are, by then,

expected to provide at least two-thirds of requirements. This pattern of supply conforms with the Government's immediate plans which will be fully achieved if increasing consumption of indigenous sulphur and greater efficiency in its use obviate the need for the Government to give financial support to this section of the sulphur industry.

The review of the industry in JAPAN is limited to the section concerned with elemental sulphur. Being one of the most abundant resources of the country, Japanese sulphur has been prominent in world markets for many decades. The post-war revival of the industry which, in 1952, resulted in 180,000 tons of sulphur being produced, has received a check, as high costs, occasioned by widely prevailing antiquated methods and low efficiency, make the exportable surplus internationally uncompetitive. In 1952, the domestic industries, i.e. principally pulp and rayon - virtually no sulphuric acid is manufactured from elemental sulphur - consumed over 135,000 tons of sulphur. The balance in that year was exported but, in 1953, after stocks rose alarmingly, Japan had to cut prices by more than 40% of production costs, to be able to sell to Australia. Extensive modernisation is being undertaken and, in view of the vast resources in the form of various types of deposits, the increased technical efficiency so attained should bring Japan again to the forefront as suppliers in the world market.

In the UNITED STATES, production of native sulphur in the third Quarter decreased 4¾%, but stocks increased by about 140,000 tons to 3,058,822 tons. As apparent sales, in line with seasonal trends and depressed by good consumers' stocks, were over 330,000 tons (22¼%) lower than in the preceding quarter. Nevertheless, the rate of apparent sales of native and recovered sulphur in the first nine months, of 5.54 million tons per annum, showed an increase of nearly 6% over 1952, in spite of reduced exports, while the production rate of 5.56 million tons per annum was in comparison reduced by ¼%. The successful start of operations at the Freeport Sulphur Company's Garden Island Bay Dome, early in December, will of course, make up the leeway which

is believed to be largely due to further cutting back of output at Texas Gulf Sulphur Company's Boling Dome.

In ITALY, renewed efforts are being made to remedy the sulphur industry's troubles. The initiative this time comes from the Sicilian Regional Government and its proposals to the Minister of Industry and Commerce, Signor Malvestiti, and to the State Treasury, are intended to speed modernisation of mines and refineries and, by the resulting improved efficiency, to reduce costs. Priced out of export markets and embarrassed by monthly additions of about 8,000 tons of sulphur to a stockpile already exceeding 200,000 tons, the Ente Zolfi Italiani, now reorganised under a Government Commissioner, are determined to find a way out of the present impasse. The unofficial offers reported during the last few days at below £20 per ton, a cut of over 30%, are perhaps the first measures.

In the UNITED KINGDOM, the abolition of controls returns sulphur to private hands on 1st January, 1954 and conveys greater liberty to individual users of sulphur. Nevertheless, the continued bulk purchase of "acid" sulphur by the National Sulphuric Acid Association, on behalf of its members, and the maintenance of licensing control by the Board of Trade, which limits the imports of sulphur for acid-making to a predetermined tonnage and subjects imports of regular sulphur to scrutiny make the changes more apparent than real. In the third Quarter, consumption of sulphur in all forms continued at the rate of over 730,000 t.p.a., 20% higher than the annual rate in 1952. The use of brimstone in sulphuric acid manufacture continued to decrease but, in view of increased use of pyrites, acid production was exceptionally high for this time of year. Acid supplies, it is reported, are at present tight. As only 40% of sulphur consumption was met by imports, sulphur stocks were reduced by about 50,000 tons. The continuation of this trend is thought to have reduced end-year stocks to a bare two months' supplies.

The decision of the United States sulphur

producers to raise their export prices, as from 1st January, 1954, underlines their determination to discourage the increasing demand from foreign users. The new export price of the two principal exporters - £31 - represents an average increase of about 15/- per ton and establishes a differential of £3 over the home market. Non-American sulphur producers continued to be faced by buyers' resistance to high prices and, with the exception of some Scandinavian and German recovered sulphur, which sold at or near American price levels, producers such as Japan and Chile were only able to sell below cost.

Export supplies of cheap United States brimstone continued to be restricted, quantitative control by the Office of International Trade having been superseded by the producers' own allocation schemes. Production capacity of non-American sulphur increased with the coming on stream of the San Cristobal Dome in Mexico, but supplies from this source are initially earmarked to meet internal needs and the eventual export surplus is being sought by American interests. Whereas stock accumulations in Japan and Chile are beginning to move, responsible quarters in Italy are disinclined to adopt similar measures as they expect a world shortage of cheap sulphur inside two or three years. In the immediate future, the recession trends in many United States industries would seem to portend a greater export availability of cheap sulphur but, so far, the chemical industry in the States does not appear to be so affected. In this connection, it may be mentioned that, whereas prominent American economists interpret the present trends in industries producing capital and durable goods to result in a 5% reduction of output, the view is expressed in some quarters that voluntary reduction of acreage under cultivation earlier this year will lead to more intensive cropping of the remainder, with the result that fertiliser use, which represents more than a third of American sulphur consumption, may, if anything, increase.

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A U S T R A L I A

The sulphur industry in Australia is almost exclusively determined by the extent of acid production for superphosphate manufacture and currently these requirements are met by imported brimstone, indigenous pyrites and the utilisation of zinc smelter gases. The dependence on imported supplies, which represented about two-thirds of the country's requirements, had serious repercussions on the industry when the sulphur crisis in 1950 imposed restrictions. In company with other consuming countries which were dependent primarily on U.S. sulphur supplies, the Australian industry determined to increase the availability and the use of indigenous raw materials. In 1951, an Executive Committee, representing the various Commonwealth Departments concerned, drew up a plan scaling down the use of imported sulphur and, simultaneously, outlining the basis for the conversion of plants and the construction of new units. At first, it had been intended to eliminate altogether, over a period of two to five years, the use of foreign brimstone. The Committee was, however, faced with a problem that this course would have necessitated not only a disproportionately large programme of capital investment, but would have resulted in an immediate substantial increase in production costs which would have had to be imposed on an industry that was already a high-cost producer. In view of this and also in consequence of the relaxation of the world supply stringency, brimstone is to continue to play its part in the Australian industry, but the main emphasis of sulphur supply is to be on indigenous raw materials. A capital investment programme of £A10 million was drawn up for immediate plant conversions and new installations and this is expected to be completed in 1954.

In this connection, it might be noted that, in the main, these plans were conditioned by the anticipated requirements of the acid/fertiliser industry,

1872 the oldest branch of the Australian chemical industry. During the war, the chemical industry had expanded spectacularly and, following a period of consolidation, employed in 1952 ten times the number of hands than in 1900, compared with only four times in other manufacturing industries. Now the chemical industry seems to be about to expand again, in particular in the field of petrochemicals, synthetic fibres and chemometallurgy, notably titanium production, which industries are in varying degrees users of sulphur and/or sulphuric acid.

The following sketch plan shows the distribution of population, industries, sources of indigenous sulphur raw materials and their present centres of consumption. From the point of view of the latter, the picture is not unfavourable, even though, at present, distances and transport costs raise many problems which, given the realisation of the above-mentioned industrial developments, may be mitigated.

Fig. I

In the main, the new production plans provide for increased utilisation of zinc smelter gases and indigenous by-product pyrites, as well as using lead smelter gases and opening up a substantial pyrrhotite deposit.

Australia lacks deposits of native sulphur and the exploration of volcanic deposits in the Australian mandated territory of Papua, New Guinea, disclosed that, although of high grade, the available quantities do not warrant commercial exploitation. Of other potential sources of sulphur, mention should be made of the extensive gypsum and anhydrite deposits, primarily in South Australia and the possibility of sulphur recovery from oil refinery gases. No plans have as yet been formulated to exploit the former, largely on account of the high capital outlay involved at a time when all available capital resources are committed to the more orthodox schemes under the conversion programme. The erection of the large Kwinana oil refinery near Perth, Western Australia, designed to use Middle East crude oil would make sulphur recovery feasible, but, so far, there is no evidence of plans to do so. The determination of the quality and the extent of the new Australian oil find may lead to developments in this field.

PRODUCTION

Details of production and exports of sulphur in indigenous raw materials are shown in the graph below:-

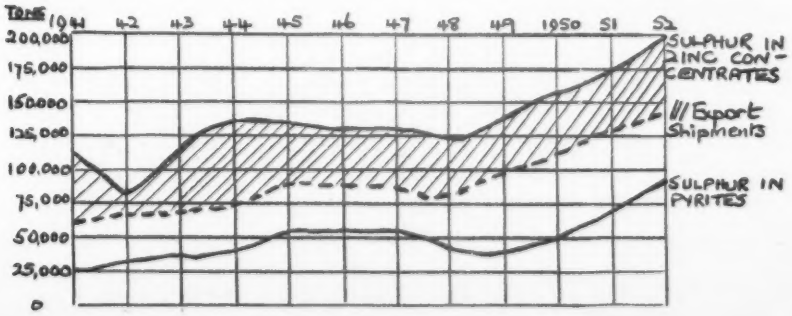


Fig. II

In the four-year period up to 1952, production of sulphur for the use of Australian industry increased about 39%, the principal contribution having been made by the increased output of sulphur in pyrites. Based on details of the new production capacities under development, the pattern of production up to 1955 is expected to be as follows:-

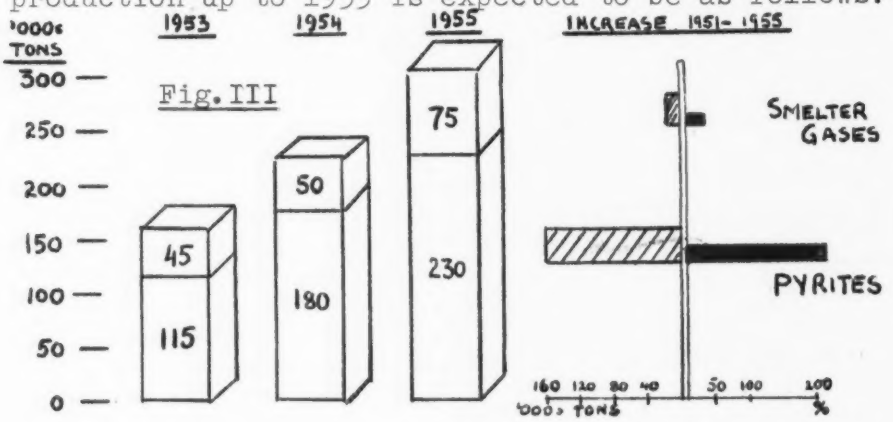


Fig. III

These estimates do not take into account sulphur contained in zinc concentrates exports.

In addition to these raw materials, the arising of spent oxide, at present at the rate of about 4,000 t.p.a. sulphur, contributes to indigenous sulphur resources.

In formulating development plans, the Australian industry based itself on a recent review of existing sulphur reserves in the form of pyrites, pyrrhotite, zinc and lead concentrates. The table on the next page gives details of estimated reserves of sulphur in various raw materials, available for acid-making*. The figures shown in brackets represent the full assessed extent of available reserves but, owing to transport difficulties (mainly cost) and the need to conform to existing arrangements, technical matters, etc., only part of these tonnages were included for practical purposes.

*Footnote: It is estimated that these reserves would meet Australia's anticipated requirements for the next 35 years, being equivalent to about 13½ m. tons brimstone.

State	Locality	(a)	(b)	(c)	(d)	Total
		(Thousands tons Sulphur)				
Queensland	Mt. Morgan	-	2284	-	-	2284
New South Wales	Broken Hill	-	-	1767	1530	3297
"	Captain's Flat	-	127	-	-	127
"	Leadville	26	-	-	-	26
Tasmania	Chester	420	-	-	-	420
"	Mt. Lyell Mine	725	-	-	-	725
"	Jukes Darwin Fields	-	1305	-	-	1305
"	Read-Rosebery	-	184	306	-	490
"	Renison Bell	283	-	-	-	283
South Australia	Nairne	5295	-	-	-	5295
West Australia	Big Bell	47	-	-	-	47
"	Iron King (Norseman)	633	-	-	-	633
		7429 (7921)	3900 (4234)	2073 (4213)	1530 (2052)	14932 (18420)

(a) Pyrite & Pyrrhotite Bodies
(b) Pyrite Concentrates from Mixed Sulphide Bodies
(c) Zinc Concentrates
(d) Lead Concentrates

Smelter Gases

Zinc concentrates are produced by Electrolytic Zinc Company of Australasia Ltd. from their deposits at Rosebery, Tasmania, the New Broken Hill Consolidated Ltd. at Broken Hill, New South Wales. Lake George Mines Ltd., at Captain's Flat, N.S.W.

and Mount Isa Mines Ltd., Queensland.

By integrating the calcination stage of zinc concentrates with acid-making fertiliser plants, the Australian industry, in the past, largely overcame the organisational and transport difficulties arising from the physical separation of mine, roasting plant and refinery, which affected more than half of the domestically treated zinc concentrates.

Electrolytic Zinc Company of Australasia Ltd.

The roasting plant at Risdon, near Hobart, Tasmania, treated in the past the domestic output of the zinc concentrates from Rosebery and about one quarter of that originating from Broken Hill. The roaster gases are utilised in a contact sulphuric acid plant built in 1948 with an annual capacity of 55,000 tons of acid. Under a £A.6 million plan of gradual centralisation of roasting facilities which necessitated the provision of ancillary installations, the Company erected a second acid plant with an annual capacity of 65,000 tons, which is now ready for operation. A third plant of similar capacity is under construction to be completed towards the end of next year. This development is being integrated with the Company's programme of fertiliser production which, in addition to superphosphate manufacture, now at the rate of 70,000 t.p.a., provides for the output of 55,000 t.p.a. sulphate of ammonia as from September, 1954. With additional centralised roasting facilities available, the three acid/fertiliser plants in South Australia, viz. Broken Hill Associated Smelters at Port Pirie, Wallaroo-Mount Lyell Fertilisers Ltd. at Birkenhead and Wallaroo, which had been roasting zinc concentrates on a toll basis, forwarding the calcined ore to Risdon for zinc refining, will thus no longer be needed.

Broken Hill Associated Smelters Ltd.

The installation of a contact sulphuric acid plant, adjacent to the Company's lead smelter at Port Pirie, South Australia, represents the first

stage of a £A.2½ million project. It is envisaged that the roaster gases containing up to 8% Sulphur Dioxide arising in the course of lead ore sintering are to be utilised for acid-making at the annual rate of 45,000 tons of acid. As soon as the alterations to the sinter plant are completed in mid-1954, the use of brimstone, which is today consumed for acid-making, would largely be discontinued.

Summarising the above, it would appear that, while prior to developments at Risdon, about 40,000 tons of recoverable sulphur in smelter gases accrued, the various new installations, making allowance for the discontinuation of arisings at South Australian acid plants, will result in about 75,000-80,000 tons of sulphur being so produced.

Pyrites

Until 1922, production of indigenous pyrites provided a large proportion of Australia's sulphur requirements but, for economic reasons, production was then discontinued until the late thirties. Since the war, the arisings of by-product pyrites obtained in the course of non-ferrous ore treatment have grown in importance. The exploitation of the Nairne pyrrhotite deposit detailed below is perhaps of the greatest significance in view of its complete integration with a corresponding acid-making plant located favourably from a transport point of view.

Mount Morgan Ltd.

This Queensland copper and gold producer assumes increasing importance in view of the large arisings of by-product pyrites resulting from the flotation of copper ores and the recovery of auriferous pyrites tailings which, in the past, were deemed not economically recoverable. In February, 1953, Government permission was granted to the Company to export the difference between an annual production of 180,000 tons of pyrites concentrates and the requirements of the Australian industry, on condition that the Company's expansion plans started immediately and that New Zealand had the right of first refusal of the exportable surplus.

railed

At present, Mount Morgan pyrites are supplied to acid plants at Port Kembla and Brisbane. The Queensland Government is reported to be constructing an ammonium sulphate plant at Brisbane at a cost of £A.8 million and it is believed that its acid requirement will be met from the roasting of Mount Morgan pyrites.

Mount Morgan continue to investigate the possibility of producing elemental sulphur, copper and gold by processes such as Orkla, Noranda, sulfidine and others, but so far, no one process has been found suitable for technical or economic reasons. The Company's development plans also include the exploitation of large pyrites reserves present in the extensive low-grade copper deposit in the Sugar Loaf area.

Lake George Mines Ltd.

The treatment of lead and zinc ores from the Company's deposit at Captain's Flat, New South Wales, currently yields about 25,000 t.p.a. pyrites concentrates. Existing plans provide for the doubling of this capacity, probably by the end of 1954. The bulk of the present output is railed to Port Kembla for acid-making.

Nairne Pyrites Ltd.

This Company is exploiting the pyrrhotite (greywacke) deposit at Gibraltar, near Nairne (30 miles from Adelaide) South Australia, which plays an important role in the conversion plans of the Australian industry. By 1954, over 70,000 tons of concentrates (equivalent to about 33,000 tons of sulphur) are to be produced annually and current output figures indicate that this target will be achieved. It may be of interest to note that there are fears in certain quarters that technical difficulties may arise in connection with the handling and roasting of the pyrrhotite concentrates but, so far, no conclusive evidence either way has come to hand.

The Company, which has a subscribed capital of £200,000, was formed in 1950 at the instigation

of the South Australian Premier, Mr. T.A. Playford, by three fertiliser companies (Wallaroo-Mount Lyell Fertilisers Ltd., Adelaide and Chemical Fertiliser Co. Ltd.*), Broken Hill Pty. Ltd. and the South Australian Government. Development received its main impetus by Electrolytic Zinc Company's plans to remove the zinc concentrate roasting operations from the South Australian works to Risdon, Tasmania, so that a new source of raw materials was needed to meet the state's acid and fertiliser requirements. Broken Hill Pty. Ltd. joined in view of their wide mining experience, in particular of open-coast mining, which is applicable to the Gibraltar deposit and were appointed managing agents of the enterprise. The South Australian Government guaranteed £800,000, thus providing the necessary capital to start mining operations and install treatment facilities. The mined ore, containing 4-14% sulphur, is concentrated, in situ, to yield a finished product, containing about 47-49% sulphur. Around the deposit, a new township, Brukunga, is being created by the South Australian Government's housing authorities. The mining project is integrated with the consuming side of the industry by the formation of Sulphuric Acid Ltd., which Company is guaranteed to the extent of £A.2 million by the Commonwealth Government and to which the four above-mentioned Companies subscribed a capital of £A.600,000. The sulphuric acid plant is to be erected on a 40-acre site near Birkenhead. Acid will be produced by the contact process from sulphur dioxide gases obtained by flash roasting the Nairne pyrites concentrates. Plant operations are expected to start late in 1954 at the annual rate of 100,000 tons acid.

Mount Lyell Railway and Mining Co.

This Tasmanian Copper producer obtains a very substantial quantity of pyrites concentrates in the course of normal ore treatment operations. Hitherto, the main obstacles to the utilisation of pyrites have been transport difficulties to the mainland, but these are gradually being overcome and shipments are now at the rate of 80,000 t.p.a. of material containing 45% sulphur, representing an increased capacity of over 25,000 t.p.a. The material moves by rail to Regatta Point and is

* and Cresco Fertilisers Ltd.

thence shipped to acid plants at Yarraville, Victoria. The railway, waterside and shipping facilities have been suitably improved to make regular transportation more economical.

Norseman Gold Mines Ltd.

Situated near Kalgourlie, West Australia, about 350 miles east of Perth, this producer operates the Iron King Mine which has a capacity of 40,000 t.p.a. which is being increased to 100,000 tons, at a reported cost of £A.300,000. In addition to selected pyritic ore, a pyrites concentrate is produced partly in conjunction with the Company's gold mining operations. The output has a sulphur content of 44-45% and it is wholly consumed by West Australian superphosphate manufacturers.

Summarising the various development projects, it would appear that, while in 1952, total output of pyrites amounted to about 200,000 tons containing over 90,000 tons recoverable sulphur, itself a remarkable level of production to have achieved in so short a time, the capacity of the industry will be raised by 1954 to an annual rate of ½ million tons pyrites containing over 230,000 tons sulphur. As this tonnage appears to be much in excess of planned roasting capacity, a substantial exportable surplus of at least 100,000 tons pyrites per annum is likely to accrue.

Spent Oxide

A small quantity of spent oxide originating from various gas works is being burnt for its sulphur content which, in the past, has been comparatively low (35-40%) and not uniform, so that the material has, consequently, not been very satisfactory. By improved methods of recovery, efforts are being made to raise the sulphur content to the customary 48-51%. Currently, some 10,000-12,000 tons of material are being supplied to the acid industry.

	a/	s
1949	-	4
50	12	5.3
51	12	4.7

CONSUMPTION

It is estimated that, during 1953, about 270,000 tons sulphur in all forms will be consumed by the Australian industry, compared with about 260,000 tons in 1952. Since 1949, the level of consumption of sulphur in all forms has increased by about 23%. The proportion of sulphur used for acid-making continues at about 95%, but whereas, at present, regular sulphur users take up only an annual tonnage of about 12,000-13,000 tons, the expansion of various sulphur-using industries, in particular, rayon and fine chemicals, will result in larger quantities being so consumed in coming years. Nevertheless, the requirements of the industry of foreign brimstone are expected to continue to decline in line with the progress of the conversion programme in the acid industry. Whereas, in 1951, the proportion of brimstone to sulphur in other sulphurous raw materials used was 5:4, in 1952, it dropped to 6:7 and at present is about 4:5.

Sulphur Imports

The purchasing of all foreign sulphur is centralised and effected by the British Phosphate Commissioners. Although the main source of supply is the U.S.A., it appears to be the policy of the Commission to obtain supplies from as many reliable sources as possible, subject to availabilities and prices in the respective markets. Norway, Italy and Japan are the principal subsidiary suppliers.

In the following graph, sulphur consumption and imports during recent years are shown, together with expected developments:-

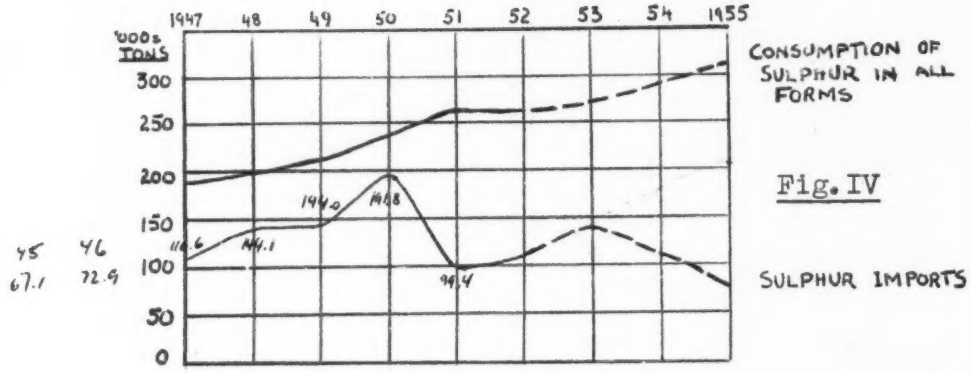


Fig. IV

Total consumption in 1955 is expected to reach about 310,000 tons, an increase of about 20% over 1951.

Sulphuric Acid

Production of sulphuric acid is at present at the annual rate of about 680,000 tons, having increased over recent years at the rate of 3-4% per annum. It is expected that this trend will continue and that, by 1955, the industry will have available an annual tonnage of 730,000 tons of acid. The use of the various raw materials is shown below, the estimate being based on incomplete data:-

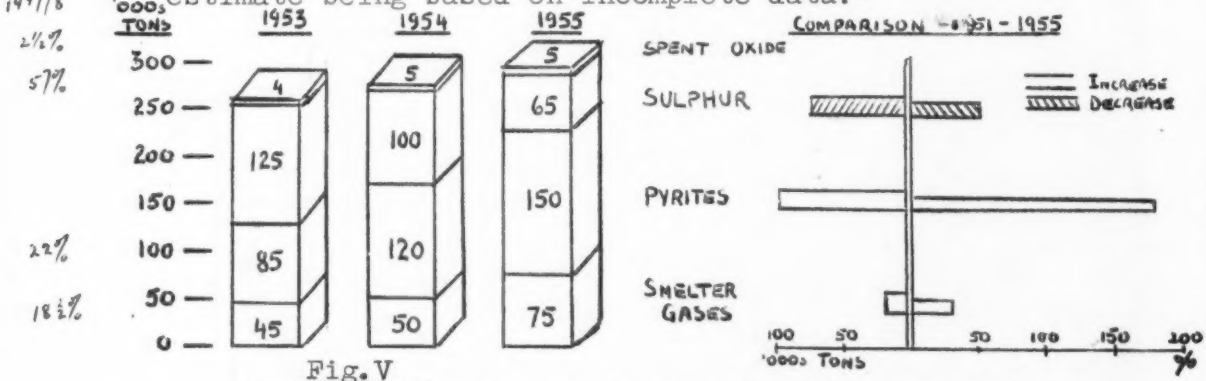


Fig. V

Owing to the increased use of sulphurous raw materials other than brimstone, the overall ratio of efficiency has dropped in recent years which accounts for the smaller increase of acid output compared with the growth of sulphur consumption.

1951: a) S - 20000 t Cotsco — All for superphosphate except small tonnage as (b)
b) S - 20000 t Adelaide Fert. — All chamber except (c)
c) BHAS - Pyrites ~220000 t — (c)(d)(e) use 4-5% by S to boost SO_2 content.
d) " 120000 t } Wall-Mal. Fert. Co
e) " 180000 t }
f) Pyrite Cones ex Nonsuch (NSW)

It may be of interest to note that, in 1951, plants using brimstone, pyrites and spent oxide were showing conversion factors not dissimilar, but a little below those in the U.K., namely 95.2%, 90% and 81.3% respectively. Plants roasting zinc concentrates were converting only 56.2% of sulphur into acid. Efforts are being made to ensure greater conversion efficiency in this section of the industry and it is expected that the concentration of acid-making from this source at Risdon will bring the figure more in line with experience in the United Kingdom and in Belgium, where 85-90% sulphur utilisation is usual.

Sulphuric acid manufacture is carried on in every state and the principal producers and works are Brisbane, Queensland(5) Cockle Creek and Port Kembla, New South Wales(4) Yarraville and Geelong, Victoria(2) Risdon, Tasmania(3) Port Pirie, Wallaroo; Birkenhead, Port Lincoln and Port Adelaide, South Australia(7) and at Albany, Bassendean, Bayswater, Bunbury, North Fremantle and Geraldton, Western Australia(6)

× Imperial Smelting & Metals/Zinc Corp Ltd

In addition to the new plants described in connection with the various indigenous sources of sulphur, mention should be made of the new and important project at Cockle Creek.* This plant, built at a cost of £A.1 million, is to have a capacity of 25,000 tons of acid.* It is to operate initially on pyrites, but may later use smelter gases from zinc concentrates.

* also 100 tpd acid superphosphate

Including the new projects under construction, there are in Australia twenty-four sulphuric acid plants, of which only four do not produce superphosphate. The actual proportion of acid used in fertiliser manufacture is about 92%. An estimate of present sulphuric acid uses is as follows:-

(13 firms)

1947/8: Simpl 83% Amm Sulph 7.5%

For superphosphates	575,000	tons
For ammonium sulphate	50,000	"
For chemicals, inc. agricultural chemicals	21,000	"
For metallurgical uses	24,000	"
For miscellaneous uses	10,000	"
Total	680,000	"

* Sulphide Corporation (Pty.) Ltd. produces H_2SO_4, superphosphate, cement
29.12.52 Agreement El Zinc to cement & pyrites roasting in return for SO_2 in chamber plant was stopped & plant adapted to pyrites roasting.
Smelter-plant being extended

It is anticipated that about one half of the increased production over the next three years will be used by the fertiliser industry and the balance is expected to be consumed in about equal proportions for the other uses listed above.

Other sulphur uses

About 3,000-4,000 t.p.a. refined sulphur are used for rubber manufacture. In view of the requirements of the new works of Courtaulds (Australia) Ltd., who produce rayon and other synthetic fibres, there is an increasing requirement for carbon disulphide currently consuming about 6,000 tons of sulphur per annum. Production is at present in the hands of Imperial Chemical Industries Ltd., who are making provision to meet the increased requirements of Courtaulds.

The balance of regular sulphur consumption goes to agriculture in the form of insecticides and fungicides to the extent of 2,000-3,000 t.p.a.

Prices

Australian sulphur consumers receive their supplies through the agency of the British Phosphate Commissioners at a fixed price, at present, of £A.25 per ton. Pyrites concentrates and ore originating from the Norseman mines† is being supplied at an average price of about £A.14.10.0d. per ton of sulphur contained, to which must be added transport costs which, in certain cases, have been known to amount to £A.14. No details are known of the valuation of sulphur contained in other pyrites or in smelter gases. It will be seen that these raw material prices are much in excess of prices ruling in other important sulphur-using countries and they are, of course, reflected in the cost of sulphuric acid. By comparison, acid prices in the U.S.A. and U.K. are as follows, according to an Australian Tariff Board Survey of 1952.

Mount Morgan
4£3 p.t. for W.M.
4£4 p.t. fob Gladstone

	In U.S.A.	In U.K.	In Australia
Sulphuric Acid (98%)	£A.10.10.0	£A.13.8.9	£A.21.10.3

† 1950 Sm exports 3|1¾ p.u
Sm ore 2|3 p.u

Conclusion

Whereas in 1951, it was expected that the complete conversion from foreign brimstone consumption to self-sufficiency could be achieved over a period of not more than five years, the apparent improvement of world sulphur supplies, together with the inevitable cost increase resulting from the use of indigenous materials has caused a reorientation and a slowing down of the plan. The principal factor can be found in the end-use of sulphuric acid in fertilisers which, if more expensive, would immediately raise the cost of food and thereby affect the cost of living index which forms the basis of all Australian wage agreements.

To mitigate some of the difficulties, the Tariff Board recommended in 1953 that acid producers using indigenous raw materials and whose costs are thereby inflated in comparison with producers using imported sulphur should, provided such an increase represented a danger to them, receive a subsidy. This is to take the form of a "sulphur bounty" which may, for the time being, be limited to £A.600,000 per annum. The suggestion of a duty on imported sulphur has been rejected as this would directly raise superphosphate costs. The position of most pyrites users is aggravated by their present inability to dispose economically of their pyrites residues. The problem is under investigation, but the availability to Australian blast furnaces of cheap and high-grade iron ores, together with the wide distribution of acid plants and the large distances involved makes its solution remote.

It now appears probable that the Australian industry will endeavour to draw supplies of foreign sulphur as long as possible and tend to develop its sulphur industry on lines similar to those envisaged in this country, maintaining approximately even proportions of foreign brimstone, indigenous pyrites and indigenous smelter gases. In view of the high level of industrial activity in general and that in the chemical industry in particular, it is likely that, over the years to come, indigenous raw materials can achieve a better competitive position, thereby relieving the difficulties which at present are putting a brake on their full development.

J A P A N

This survey is limited to the review of elemental sulphur production and consumption. It is proposed to examine production and consumption of sulphur in other forms, notably pyrites, in a later article.

General

Sulphur is one of the most important and abundant natural resources of Japan. Its occurrence and exploitation has been referred to since the eighth century and it is reported to have been exported to China in the thirteenth century. In the first two decades of this century, exploitation of sulphur was intensive and Japan became the third largest producer of sulphur in the world, averaging about 50,000 t.p.a. and, during the first world war, exceeding 100,000 t.p.a. Owing to the absence of significant domestic needs, most of the output was exported, principally to the United States, Australia, Canada and China.

The development of the rayon and pulp industries in Japan in the mid-twenties created a growing internal demand, thereby stimulating production until, in the late thirties, output of sulphur exceeded 200,000 t.p.a. At that time, twenty-five to thirty major mining enterprises were operating, the majority, however, employing primitive mining and refining methods. After almost complete cessation of production at the end of the second world war, the industry revived and production is approaching pre-war levels. Early in 1953, thirty-two important mines were operating and, as the result of Government support, much modernisation was taking place. Owing to high production costs, however, the Japanese producers are no longer able to enter export markets competitively and the current re-organisation of the industry is aimed at redressing this. In addition to the above-named uses, which account for the bulk of the domestic sulphur

consumption - virtually no sulphuric acid is produced from elemental sulphur - there is a growing demand for sulphur for agricultural purposes, rubber and fine chemicals.

Deposits

All Japanese sulphur deposits are the result of volcanic activity. As shown below, most of them are situated in the Kuriles, Nasu and Kirishima volcanic belts and only a few are situated in the Fuji and Hakusan areas. Deposits are generally grouped close together and there are practically no cases of single development.

Fig. VI

Known sulphur reserves are very extensive and, apart from known unexploited or even unassessed deposits throughout Japan, many new discoveries are likely to be made in the sulphur regions of Hokkaido and Honshu which have, so far, not been thoroughly prospected. In view of the multiplicity of deposits, the variety of their natures and the wide divergence of technical methods employed, it is not possible, at present, to make an accurate assessment of the national potential or the rate of probable development of the industry, particularly with regard to the type of source that may ultimately prove to be the most economical and plentiful to exploit. Sulphur deposits can be classified under four main types:-

1. Sulphur Flows are formed by the flow of molten sulphur which has coagulated above ground, usually following volcanic eruptions. ~~They include the following:- Shiretoko (Hokkaido), Kurigome, Yakeyama.~~ Ugusu - Iwate

2. Sublimation Deposits are comparatively small and are usually found in the vicinity of craters as the result of solfatara and fumarole activities. This natural process is frequently supplemented by artificial means whereby hydrogen sulphide gas activity is directed into tunnels where sulphur is deposited. Exploitation of sublimation deposits, and also of sulphur flows, is nowadays quantitatively negligible and still rather primitive, although their number is large. In the past, from time to time, they accounted for a large proportion of Japan's sulphur output. ~~Sublimation deposits under active exploitation include Atosanabori,~~ Kawonarage, Motoshirane, Shiratori. The development of an efficient recovery process to utilise the sulphurous gases at present escaping to the atmosphere from the numerous fumaroles throughout the islands would substantially add to reserves.

3. Sedimentary Deposits are formed by precipitation of elemental sulphur in hot crater lakes during the latter stage of volcanic activity. These deposits are usually of high quality containing 50-80% sulphur. ~~Deposits already exploited include Kimobetsu and Iwaonobori and those in~~

course of exploitation Noboribetsu, Yusawa and Zao. Their exploitation at present accounts for about 8½% of total production, but several new deposits are under development and, as these lend themselves to economic open-cast mining, their importance to the industry is thought to be increasing.

4. Impregnation and Replacement Deposits formed, in the main, by the action of hot acid springs, rich in sulphurous gases and iron, are solidified ash. The ore contains usually 35-40% sulphur and is, as the result of further geological influences, often associated with pyrites. This ore is frequently referred to as rock sulphur and usually contains minor amounts of barium, arsenic and selenium, which cannot wholly be eliminated in the course of refining. Among deposits in course of exploitation, Numajiri and Ogushi might be mentioned and the large complex deposits of Horobetsu, Azuma and Matsuo also fall into this category. This type of deposit is the most extensive and represents over 90% of known reserves. Similarly their output, in particular from the complex Matsuo deposit, accounts for all but a small proportion of Japanese production.

Mining

The bulk of Japanese sulphur ore is obtained by underground mining operations which follow conventional lines, such as pillar and stall and cut and fill methods. In the larger mines, such as Matsuo, increasing use is made of mining machinery with a view to raising extraction efficiency from the low levels of under 30% that widely prevail. Open-cast mining is applied at some sedimentary deposits.

Refining

Some of the sulphur producers continue to employ the old-fashioned Daran method which is similar to the calcarone process used in Sicily and equally wasteful and inefficient. Over 80% of Japanese sulphur is obtained by retort distillation and steam autoclave. Ore preparation for these refining methods is being increasingly

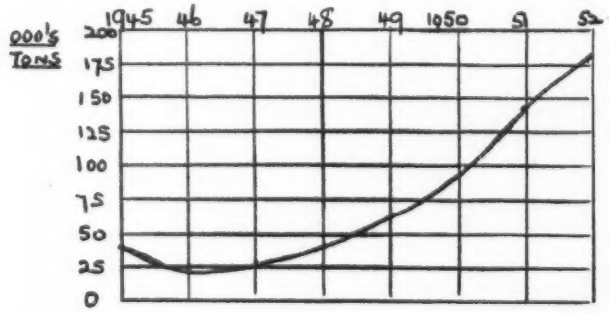
mechanised, particularly on the larger mining properties and hand-picking in milling is now virtually superseded.

Only three of the largest producers treat fine ore, normally unsuitable for these refining methods, by flotation and then refine the concentrate, containing 60-80% sulphur, by steam autoclave. Usually the fine ore is dumped although, in some cases, it is sold to acid makers for sulphuric acid production. In view of the high cost and comparatively low efficiency of the above standard methods, the Government is encouraging the use of more up-to-date refining methods, such as the use of carbon disulphide and other solvents. No details are as yet available as to what proportion of the industry has changed its refining process in this way. Another development of importance (as reported in Bulletin No. 2) is the installation of a Masobello plant at a hitherto unexploited Musa deposit in Northern Hokkaido.

PRODUCTION

The following graph indicates development of sulphur production during the period 1945 to 1952.

Fig. VII



The principal producers were as follows:-

Name	Average 1935/9	1949	1952
		Metric tons	
Azuma	6,507	6,017	13,239
Horobetsu	31,270	1,289	7,346
Ishizu	-	2,799	8,249
Matsuo	56,999	22,490	61,298
Miyagawa	2,212	0	7,902
Numajiri	14,089	4,657	7,478
Ogushi	16,391	8,334	14,385
Zoa	3,307	3,591	7,113
Others	74,724	13,304	52,476
Total	205,499	62,481	179,486

Production plans for 1953 provided for an output of 217,000 tons, an increase of about 20%. Owing to export difficulties, it is not thought likely that more than 140,000-160,000 tons will actually be produced. In view of the present uncertainty of the rate of modernisation, re-equipment and possibilities of opening new deposits, a forward estimate of production is not warranted.

CONSUMPTION

Sulphur consumption in Japan in 1952 amounted to 135,612 metric tons, a decrease of 3½% compared with 1951. The following graph shows relevant consumption figures by the various sulphur-using industries during the period 1948-1952.

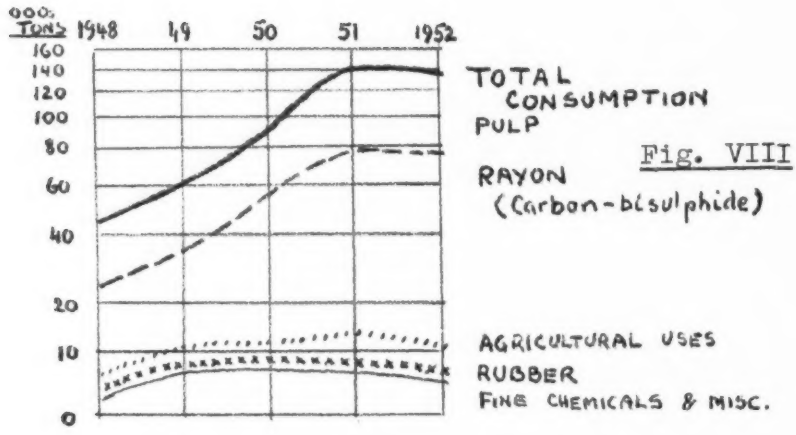


Fig. VIII

For 1953, it had been anticipated that consumption would increase about 12-15%. From indications during the first half year, it would, however, appear that consumption remained at about the same level, if not slightly below that in 1952.

Trade and Prices

The availability of exportable sulphur from Japan is of major importance to sulphur-using industries in the Far Eastern area. Details of exports during the period 1948 to 1952 were as follows:-

1948	1949	1950	1951	1952
		Tons (Metric)		
600	20	511	Nil	42,696

Although the revival of Japanese industry was too slow to alleviate the world shortage in 1951, the exports in 1952, made in accordance with I.M.C. allocations, were valuable. These were directed to Australia, New Zealand, India and Brazil. Although Japanese industry had hoped to export, in 1953, 65,000 tons, actual exports in the first half-year were only about 2,300 tons. This lack

of foreign markets was primarily due to Japanese production costs necessitating export prices approximately two to three times higher than the price of American sulphur.

By mid-summer 1953, stocks estimated at 20,000-30,000 tons had accumulated owing to failure to export and to slightly reduced home consumption. Coupled with Japan's urgent need to earn sterling, this led to a sale of 10,000 tons to Australia at a landed price of £16 per ton which, allowing for a reported freight of 62/6, appears to be about 40% below known Japanese production costs. Further shipments at similar prices are currently envisaged. It is understood that, at present, the whole question of sulphur exports is under review and it may well be that, until the necessary plant alterations have been effected, only nominal tonnages may find their way into export markets.

Conclusion

The difficulties encountered by the Japanese sulphur industry are common to all sulphur-producing countries using methods other than the Frasch process. In view of the Japanese home market for sulphur being based on industries other than acid-making, the trade fluctuations, particularly in the textile industry, have serious repercussions on sulphur disposals. The present trend in re-equipping the industry is unlikely to show quick results and, whilst it is probable that, during the next two years, moderate tonnages, say up to 30,000-50,000 t.p.a., will become available at or near world market prices, the Japanese home consumer may be obliged to bear the burden imposed on him by the less efficient section of the sulphur industry. It remains to be seen whether industry or Government are prepared to provide the larger amount of capital required for the extensive modernisation of mines and refining plants. In view of comparatively cheap labour being available, increased technical efficiency should, without any doubt, make Japan a very important and internationally competitive source of sulphur supply.

PRICES AND TRENDS

United States of America

With effect from 1st January, 1954, the price of sulphur exported by the principal United States producers has been increased as follows:-

	Old	New
	per ton f.o.b. Gulf Port	
Texas Gulf	$28	$31
Freeport	$30.50	$31
Jefferson*	$30.50	$33

*It is not known whether the new price charged by Jefferson Lake Sulphur Co. is their general export price or whether it is applicable only in specific markets. No details are as yet known of the changes in the price to be charged by Duval. The above prices apply to bright sulphur, the discounts for darker qualities remaining unchanged.

The decision to increase prices is not surprising although, as mentioned in Bulletin No. 2, it was not expected to take place until later in 1954. It emphasises the disincentive on the part of the American producers, in particular Texas Gulf Sulphur Company, towards their keen overseas customers and yet, compared with other commodities, sulphur prices still show the least increase compared with pre-war (1939) levels. It is thought probable that the continuation of the present tight supply position will result in further increases in the export price of U.S. sulphur. Their imposition and extent is expected to be governed largely by the availability and the level of prices of non-American sources of efficiently produced sulphur.

Domestic sulphur prices - at $28 per ton - in the United States are not affected by the latest increase, although minor adjustments are believed

to have taken place. It might be added that the increase of 1st June was reflected by a corresponding increase in sulphuric acid prices which rose, in early September, from $20 per ton ex-works (tanks) to $22.35.

Italy

The developments of the Italian industry are reviewed on page 35 and some price repercussions are already becoming manifest. According to a recent report, Italian sulphur is available for export at Lire 35,000 (£20) (f.o.b.) or about £8 below the price level in the domestic market which, as it will be recalled, was, until recently, on par or slightly below that of their export prices. It is not known whether actual sales have been effected.

Chile

As the result of the stagnation of sulphur exports referred to in Bulletin No. 2, considerable pressure was being brought to bear on the Chilean Government by the various sulphur interests. This resulted, in the early Autumn, in the Government's acceptance of the principle of internal compensation whereby the sales price in Chile of imported capital goods, motor cars, etc. was to be inflated to provide for the difference between the real price of sulphur and the price at which it could be exported. The arrangements of individual transactions were left in the hands of the trade, with the disposal arrangements of sulphur being left in the hands of I.N.A.C.O. (National Institute of Commerce). In consequence, many offers were submitted to trade circles in the United Kingdom, France and Western Germany at price levels ranging from about £10.10.0 to £12.0.0 per ton f.o.b.

The following table shows a comparison of prices of sulphur of different origin. F.o.b. prices and freights are based on recent quotations.

	f.o.b. Country of Origin	Freight to U.K.	c.i.f. U.K.
United States	$31 ($33)	46/- $16.50*	£13⅜ & £17 Av. say £14
Italy	£20	32/6	£21¾
Chile	£10½ - £12	75/- (liner) 66/- (tramp)	£14¾
Japan	$38†	104/- (liner) 70/- (tramp)	£17 - £18¾
Germany	-	-	£14¾ - £15
Canada	$18.50	£18	£24½

* 50% of U.S. sulphur exports have to be moved in U.S. bottoms; whereas U.S. liner freights are at present equivalent to about 50/-, U.S. tramps usually command premium freights.

† calculated on the basis of their offer to Australia. The freight quotations shown are tramp charter and liner terms respectively.

In the last three months, the supply position of cheap sulphur has remained virtually unchanged. As a result of the new American (Garden Island Bay) and Mexican (San Cristobal) Domes coming on stream, trade sentiment throughout the world appears to have improved. Home market requirements in the United States, however, have not shown any appreciable slackening and foreign demand continued to be held in check by the American producers' own allocation schemes following the abolition of quantitative control by the Office of International Trade at the beginning of October, 1953. In connection with sulphur supplies from Mexico, it might be mentioned that the first 30,000 tons from San Cristobal are reported to be earmarked for the Mexican Government and that American consumer interests are anxious to secure the remaining output. The export tonnage of rock sulphur of which, earlier this year, Spain purchased several thousand tons at a price believed to have been in the region of $40 f.o.b. are no longer arising as the important Mexican rock sulphur producer, Cia. Minera de Azufre, ceased

producing in September, due to financial difficulties. The Japanese stockpile has been further reduced by a sale to Australia for shipment in the New Year at a price comparable to the earlier sale effected at £16 c.i.f. Sulphur stocks in Italy and, to a lesser extent, in South American countries, where production was further cut back, continued to mount. The earlier free offerings of Scandinavian and German sulphur ceased about the end of November when the pulp and paper industry regained its earlier level of activity and absorbed virtually all indigenous sulphur availabilities. The recent disposal of a parcel of about 10,000 tons from Norway to Australia is reported to be the only and last exception. In connection with the sales of recovered sulphur from Germany in September and October, it might be noted that these were effected at c.i.f. prices below those of American sulphur, the German suppliers having taken advantage of the favourable situation of the neighbouring markets, notably in Belgium and Switzerland.

In view of the dependence of the world sulphur supply position on the activity in the United States domestic market, the recent comments by the American administration on the recession of business in the United States are significant. Whereas the steel rate has dropped nearly 30 points in the last five months to 67 and the weekly average hours worked in industry have dropped below 40, for the first time since 1949, there have, so far, been no indications of recession trends in the chemical, notably the sulphur-using, industry. Acid demand is reported to be satisfactory and, in view of new consumers entering the field in the New Year, is expected so to continue.

There is no doubt that an aggravation of recession trends in other industries must sooner rather than later be reflected in the chemical industry, but the avowed intentions of the administration to prevent the recession from getting a hold on the country are well-known. If these should, however, fail, with the result that substantial sulphur tonnages would become available to foreign users, their reduced dollar earnings, notably in the United Kingdom, would make the securing of greater supplies problematical.

UNITED STATES SULPHUR

Native Sulphur

Production during the third quarter of 1953 amounted to 1,290,070 tons, about 4¾% less than during the corresponding period in 1952 and the second quarter of 1953. Production in September of 415,641 tons was exceptionally low, lower in fact, February productions apart, than during any one month for about three years. Total output for the nine months of 1953 was at an annual rate of about 5¼ m. tons which is nearly 2¼% lower than during the corresponding period of 1952.

Apparent sales during the third quarter, amounting to 1,150,793 tons, were about 2% lower than during the corresponding period of 1952 and over 330,000 tons (22¼%) lower than during the second quarter of 1953 when, as will be recalled, sales were exceptionally high. Export shipments during the third quarter are estimated to have been about 10% lower than those during the preceding quarter which amounted to 355,935 tons. The reduction appears to have been deliberate on the part of the producers, but the tonnage is similar to that exported during the same period of 1952.

The earlier trend of decreasing stocks had been arrested in June and the improvement of the stock position continued throughout the third quarter. Total additions amounted to 139,277 tons bringing total stocks to 3,058,822 tons, which is about ¾% below the figure at the end of September, 1952.

Recovered Sulphur

Total production during the third quarter amounted to 84,806 tons, an increase of about 26½% compared with the corresponding period in 1952, but about 2¼% less than during the second quarter of 1953. The decrease is due to the level of September production being nearly 6,000 tons below

that of preceding months.

The level of apparent sales continued high throughout the third quarter and the total amounted to 92,958 tons which is 8% higher than during the corresponding period of 1952 and 8¼% higher than during the preceding quarter.

Stocks of recovered sulphur at the end of the third quarter amounted to 119,778 tons compared with 127,930 tons at the end of June, a decrease of 6½%.

MONTHLY PRODUCTION FIGURES 1952 to 1953

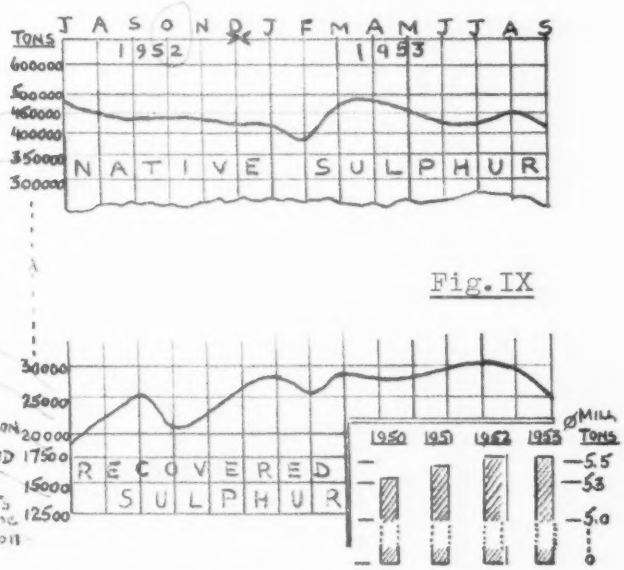


Fig. IX

The salient points in the developments in the United States industry during the third quarter of 1953 are thought to be as follows:-

(a) Total production of native and recovered sulphur were about 66,000 tons or 4.6% below that of the preceding quarter.

(b) The seasonal decrease of deliveries to the home market was accentuated due to most consumers carrying satisfactory stocks obtained before domestic prices rose on 1st June, 1953.

During the Autumn months, the supply position in the home market was reported to be favourable and the news of Freeport Sulphur Company's success at Garden Island Bay Dome was received throughout the industry with much satisfaction. As yet, no significant easement of the supply position in the New Year is expected as several large sulphur consuming plants are due to start operating. The progress and intensity of the present recession trends in the United States and their repercussions on sulphur-using industry will, of course, be determining factors. If, as the result of lower home consumption, producers should be in a position to build up their stocks to, say, one year's supply, which it is reported Texas Gulf Sulphur Company are anxious to do, this would receive approval in all, but particularly in Government, quarters.

FREEPORT SULPHUR COMPANY

During the first week of December, production started at the Freeport Sulphur Company's new Garden Island Bay dome at the mouth of the Mississippi River. Situated one hundred miles south-east of New Orleans, in remote and desolate marshland, it is the largest of four new dome projects undertaken by the Company. When in full operation, this new source is expected to yield ½ million tons of sulphur annually, which makes it the largest single sulphur mining development in the world since 1933. In view of the complex engineering and construction problems, the capital cost of the project is £14 million. Before construction could start, the marshy site, lying only one to two feet above the level of the nearby Gulf of Mexico, had to be filled with hundreds of thousands of cubic yards of mud. The foundations for the plant supplying the superheated water and compressed air consist of several thousand concrete piles, which are driven into the clay sub-soil and which support a 16-inch concrete mat on top of which are 16-feet high concrete cells. The main floor of the plant is raised to this level, as a precaution against high water during storms.

The caprock of the dome is 1750-1850 feet below the surface and the Garden Island Bay plant is designed to pump 3½ million gallons of superheated water (325°F) into the deposit every twenty-four hours. Although Freeport Sulphur Company have largely overcome the problem of using salty water in their boiler plant, water supplies are drawn from the Mississippi at a time when salt intrusion from the Gulf of Mexico is at its lowest, usually from February to June and it is stored in two earthen reservoirs constructed in the marsh. These reservoirs occupy an area of about a square mile and hold nearly 1,000 million gallons of water. The mining area itself is more than a mile away from the power plant. The molten sulphur is freed of air and metered at a relay station and pumped directly into insulated tank barges and transported upstream for storage at Port Sulphur. The main site itself can be reached only by boat or seaplane and it is noteworthy that the only other large industrial plant within a 75-mile radius is another sulphur plant, Freeport's Grande Ecaille Mine. Garden Island Bay Dome is a vital contribution to existing sources of low-cost sulphur. Its output comes on the market at a time of rising demand in the United States and the threat of decrease of output from older sources of Frasch sulphur. For this reason, it is thought unlikely that it will make a substantial contribution to available export tonnage. In this connection, the recent press statement made by Mr. Langbourne Williams, President of the Company, may be of interest:- "Sulphur from these new mines", Mr. Langbourne Williams said, "will be an important factor in helping to meet a demand which is straining the industry's present productive capacity."

SULPHUR IN ITALY

As the result of the Ente Zolfi Italiani's inability to find export markets for sulphur due to high prices, the Sicilian Regional Government made representations to the Minister of Industry and Commerce which, by the end of November, led to the prospect of early talks. It is claimed that

emergency measures are necessary in order to prevent the possible closing of mines which would result in throwing out of work the sulphur workers who represent the largest single group in the Island.

The following recommendations have been made:-

1. A guaranteed price to mine owners to apply to production for the next six years and also to existing stocks in the hands of E.Z.I., as follows:-

Present stocks and output of next two years to be sold at 42,000 lire per ton and during the subsequent four years, an annual reduction of 1,000 lire per ton to an ultimate price of 38,000 lire per ton is proposed. It is claimed that the progressive reduction of the guaranteed price would act as an incentive to mine owners to carry out plant modernisation. The marginally producing mines, which could not subsist at these price levels, are thought to require a special grant up to 1955, during which time they would have to put their house in order.

2. At present, the mine credit section of the Bank of Sicily carries a debt of 6 milliard lire for financing sulphur stocks. It is recommended that an interest-free advance should be made to E.Z.I. or, alternatively, E.Z.I. should make a bond issue for this amount and be reimbursed by the state for interest paid on such bonds.

3. In connection with modernisation of plants, it is recommended that:-

(a) Instead of mine owners having to find the necessary guarantees qualifying them for advances from the 9 milliard lire fund set aside to assist this work, these should be provided by the Regional Government or, alternatively, E.Z.I. should be empowered to guarantee advances against an undertaking by owners to give up a proportion of annual production equal to the amount of amortisation of the advance.

(b) Available funds for advances be increased from 9 milliard to 12 milliard lire and that the purchase of machinery be added to the purposes for which the loans can be used.

It is also recommended that the Government should look into the possibility of opening up to the industry the markets in Eastern European countries and that an agreement should be sought with the United States establishing spheres of influence at agreed market prices.

With a view to exercising direct control over a proportion of Regional Revenue, the Regional Government has submitted two suggestions to the State Treasury. These are that the Regional Budget should:-

(1) Sustain the total cost of experimental work on new methods of refining.

(2) Grant considerable sums for work and material required to improve security and working conditions in the mines and thus improve output.

This comprehensive approach to the Italian, but in particular Sicilian, sulphur problem was started at a preliminary meeting early in December under the auspices of the Ministry of Industry and Commerce.

It was resolved that more intensive technical studies regarding the modernisation of mines be undertaken and that a memorandum embodying the Regional proposals be submitted to the Italian Treasury forthwith to be followed by a meeting of all interested parties. It is understood that the question of prices was not broached at this meeting, as it was thought expedient to obtain Treasury approval to the other proposals first.

In November of this year, the structure of the E.Z.I., which central organisation collects the national sulphur output, effects all sales of sulphur at home and abroad and regulates the price, was reorganised into two separate divisions, one commercial,

under the directorship of Signor Salerno, and one technical, under the directorship of Dr. Gerbella. At the head of E.Z.I. is now a Government Commissioner, Signor Maestrobuono (Private Secretary to the Minister of Industry and Commerce) with direct responsibility to that Minister, Signor Malvestiti.

It will be recalled that Italian sulphur stocks have been rising since early this year and have attained a level of about 220,000 tons, of which about 80% is of sufficiently high grade to be exportable. The additions to the stockpile are, at present, at the rate of about 8,000 tons exportable sulphur per month. Production continues at a high level, at present about 240,000 t.p.a. since producers, under the existing E.Z.I. system, are paid by Banco di Sicilia against warehouse warrants about 40,000 lire per ton of sulphur delivered to warehouse. This figure is based on average production costs which are computed by E.Z.I. on the basis of returns from all sulphur mining enterprises, efficient and uneconomical alike and the resultant home and export sales price, as well as the actual marketing, are removed from the responsibility of individual producers. The regional recommendations seek a modification of the present system whereby more extensive protection of producers is to be accompanied by a lowering of individual production costs. It is significant that Italian sulphur producers and Government circles contend that the maintenance of the existing stock is justified since they anticipate a recurrence of the sulphur crisis within two years when the disposal of stocks at exceptional prices is envisaged. This view does not imply any lack of determination to bring about the rationalisation of future production and a resultant lowering of export prices and it is understood that, in the near future, these are to be arbitrarily reduced by about 15% to Lire 40,000 per metric ton (about £23 per ton) or even lower.

There appear to be no special reasons why the larger and more efficiently organised mines, which are installing new plant, could not reduce their production costs to internationally competitive levels, in particular, if Government assistance in respect of interest charges were received. To be

effective, however, this would demand the revision of the present system of averaging production costs. Italian sulphur affairs have now reached a stage when only determined measures by the Government can remedy the confused situation that has arisen. It is, however, not thought that decisive results can be expected at an early date.

FREEDOM FOR UNITED KINGDOM SULPHUR

On 12th December, 1953, in the House of Lords, Lord Woolton, Minister of Materials, announced that trading in sulphur and pyrites would cease to be carried out by his Ministry and, after a period of thirteen years, would revert as from 1st January, 1954, to private hands. This announcement was followed by the rescinding of statutory orders controlling pyrites, sulphur and sulphuric acid. The Government's welcome decision to terminate public trading was known to the industry early in the year and the detailed exchanges of view between the Ministry and representatives of the industry which preceded the announcement emphasised the Government's desire to ensure a smooth changeover and the continuity of its policy.

Although the industry has now freedom, no immediate changes are likely to become apparent. The National Sulphuric Acid Association, which had been acting as the Government's purchasing agent for pyrites and sulphur, has been entrusted by its members to continue bulk purchasing of sulphur. Present policy appears to be to look to the United States as the principal supplier of elemental sulphur. This arrangement will undoubtedly appeal to the American sulphur producers who are known to be reluctant to enter into a number of small individual contracts, but it will do little to reduce this country's dependence on American supplies, or bring any nearer the possibility of securing increased tonnages, preferably of sterling sulphur.

The import of sulphur will be subject to licensing control by the Board of Trade and, as far

as "acid sulphur" is concerned, remain quantitatively restricted to the estimated need of the industry at a figure which is deemed to represent the balance of requirements for the production of acid that cannot be met by other raw materials. This restriction is designed to ensure the full employment of the new plants which, on Government recommendation, were converted to or erected for the use of imported pyrites or indigenous anhydrite. Such plants operate more expensively and involve high capital expenditure, with the result that acid so produced costs up to 30% more than that produced from brimstone, despite the fact that, during recent months, brimstone plants have only been able to operate at about two-thirds capacity. It is also feared in some quarters that the average level of acid prices may further increase as more acid plants using flotation pyrites come into operation, since blast furnaces are unwilling to take up the residues, with the result that the net cost of sulphur so consumed is raised. The users of regular sulphur, notably the rayon, rubber and fine chemicals industries are, of course, not affected by these considerations and, although their requirements will be subject to Board of Trade scrutiny, they can count, given adequate availability of supplies, on receiving all the sulphur they wish to consume.

The abolition of controls is expected to result in an adjustment of the price of sulphur paid by the consumer. The controlled price of £14.10.0d. per ton is believed to have included a premium of 30/- to 35/- per ton, which had been imposed with a view to widening the margin between the price of brimstone and sulphur in pyrites. In future the consumer will undoubtedly pay a "real" price which, in the case of American sulphur, is expected to be, on average, £14.0.0d. per ton, allowing for the recent United States price increase.

The disturbing factors in the acid industry cannot be ignored and the national interest makes it essential that they are resolved in a way that will strengthen the industry without imposing any additional burden on the many other industries dependent on it.

UNITED KINGDOM SULPHUR

During the third quarter of 1953, consumption of sulphur in all forms amounted to about 183,000 tons, which tonnage is fractionally below the figure for the second quarter. The trend of lower elemental sulphur consumption continued as the result of its reduced use for acid-making, but was nevertheless 15% higher than during the corresponding period of 1952, but 14% lower than in 1951.

It is estimated that, of the above total consumption, 34½% was met from indigenous sources (sulphur in spent oxide, anhydrite, zinc smelter gases and recovered from oil refining), 25% in the form of imported pyrites and 40.5% in the form of imported brimstone.

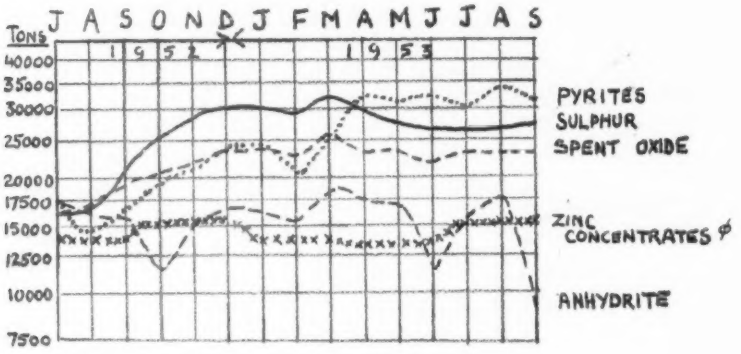
The following raw materials were consumed:-

	3rd Qtr. 1953	2nd Qtr. 1953	% Change	3rd Qtr. 1952	% Change
	Tons				
Sulphur (a) Acid	57,800	61,800	-6½	41,000	+41
(b) Regular	22,600	21,700	+4	12,800	+77
Total	80,400	83,500	-3¾	53,800	+49½
Pyrites	96,200	95,900	+¼	48,500	+98
Spent Oxide	69,100	68,700	+½	52,000	+33
Zinc Concentrates	45,800	40,000	+14½	40,800	+12
Anhydrite	43,400	45,700	-5	49,200	-12

The percentage figures shown indicate the change between the earlier periods and the 3rd Quarter, 1953.

The monthly consumption figures of raw materials are depicted below:-

Fig. X



ϕ Note: Graph based on quarterly data

Sulphuric Acid

Production during the third Quarter amounted to 452,400 tons, a decrease of 1½% compared with the second Quarter and an increase of 43% compared with the third Quarter of 1952. Acid production resulted from the use of sulphur-bearing raw materials in the following proportions:-

	3rd Qtr.1953	1952
Sulphur	36½%	43%
Sulphur in Pyrites	28½%	20%
Sulphur in Spent Oxide	21%	22%
Sulphur in Anhydrite	5½%	6%
Sulphur in Zinc Smelter Gases	8½%	9%

During the third Quarter, overall utilisation of capacity amounted to 78.1% compared with 81.3% in the second Quarter. Chamber plant capacity was reduced by 2% and its employment fell by 4%, representing about 11,000 tons acid. Although employment of contact plant capacity fell by 3%, production increased by about 4,000 tons acid as a result of overall capacity being increased by 5%. It is believed that the employment of sulphur-burning capacity was further reduced in the third Quarter to about 60%.

Stocks

During the third Quarter, sulphur stocks declined further by 50,000 tons and end-September inventories amounted to only 109,000 tons. Pyrites stocks at 505,000 tons, showed a fractional increase (¾%) on end-June inventories and spent oxide stocks declined further to 185,000 tons, a decrease of about 5%.

The most significant features of sulphur developments during the third Quarter are:-

(a) The maintenance of high sulphuric acid production at a rate in excess of 1.8 million tons per annum.

(b) The continued reduction of elemental sulphur consumption for acid-making, resulting in the lower employment of installed capacity.

(c) The continued running down of sulphur stocks which, if continued to the end of the year, as is thought inevitable, will leave barely two months' consumption in hand.

CURRENT EVENTS

International Materials Conference

It was announced on 29th December that the Central Group of the I.M.C., which since early October, 1953, had been on a stand-by basis, following the dissolution of the last commodity committee, will now be dissolved too. This decision will be deplored in many quarters as it had been hoped that the administrative machinery of the Conference could be kept in being, so that, in case of need, the specialised groups could quickly be reconvened.

In this connection, it will be recalled that,

at a Meeting in Paris in October, 1953, representatives of sixteen Governments reviewed the sulphur situation during 1953 and 1954. The Meeting concluded that the apparent favourable margin between production and consumption of sulphur in 1953 will narrow in 1954 owing to consumption increasing more than the anticipated expansion of output. Arrangements were also agreed for further international consultations to review the sulphur situation, probably in mid-summer 1954.

Imperial Chemical Industries

According to unconfirmed accounts, experimental work conducted by I.C.I. engineers at their anhydrite plant at Billingham, County Durham, have resulted in substantial operating economies and improved efficiency in sulphuric acid production from this abundant indigenous raw material.

It is further understood that parallel investigations have resulted in the successful application of the Boliden/I.C.I. Process to anhydrite roaster gases for the production of elemental sulphur at a cost comparing favourably with sulphur originating from several non-American sources.

At present, I.C.I. sulphuric acid production from anhydrite at their Billingham Works is at the rate of about 100,000 tons of sulphuric acid per annum. Since the plant was started up in 1930, over $2\frac{1}{2}$ million tons of anhydrite have been used at Billingham for sulphuric acid production. Existing capacity is being increased to produce a further 75,000 tons of acid per annum and the new installations are expected to be completed in about a year's time.

Canada

International Nickel Company of Canada Ltd. is reported to have started the construction of their $16 million plant at Copper Cliff. The new plant will permit the treatment of nickel-bearing pyrrhotite ores in a manner that will ultimately yield an annual tonnage of about one million tons of high-grade iron ore. Ore treatment in the existing

plant results in arisings of pyrrhotite tailings which are being dumped.

Mention might be made in this connection of the new process for the production of elemental sulphur from sulphide flotation concentrates, such as pyrrhotite, which has been developed by the Division of Mineral Dressing and Process Metallurgy at the Mines Branch in Ottawa. The process involves oxygen being passed through finely ground pyrrhotite in suspension in an autoclave. Selective oxidation of iron at controlled temperature and pressure yields pure sulphur and an iron oxide which, when sintered, makes an excellent blast furnace feed.

United States of America

The Davison Chemical Corporation is to start production at its new triple superphosphate plant at Bartow, Florida, in January, 1954. Using elemental sulphur, production of acid will be at an annual rate of 200,000 tons.

The General Chemical Division of the Allied Chemical & Dye Corporation announced in November, 1953, that new acid capacity was to be installed at the Company's Detroit Works additional to that put into operation in October, which will make this the largest of the Company's twenty acid plants in the United States and Canada. The new installation, due to start operating in August, 1954, is required to keep in balance supplies with anticipated demand in the area. Currently, the Company has also under construction acid plants at Painesville, Ohio and at Baton Rouge, Louisiana.

France

The Cie. de Raffinage Shell-Berre announced that, on 13th November, 1953, production of sulphur started at their Berre l'Etang Oil Refinery. Sulphur is recovered from oil refinery gases and is expected to accrue at the rate of 4,000-5,000 tons per annum.

At present, France imports almost all her

sulphur needs from the United States and, although the existing Trade Agreement with Italy provides for imports at an annual rate of 52,000 tons, only negligible tonnages are being drawn from this source, due to high Italian prices. Indigenous production of rock sulphur by the Societe Languedocienne de Recherches et d'Exploitation Minieres continues to be suspended.

As from 1st January, 1954, the price of sulphur payable by French consumers will be reduced by one franc per kilogram (20/9 per ton) to frs.2050 per 100 kgs. (£21.5.0d. per ton) f.o.r. sea port/frontier for imported sulphur or ex-works for home-produced sulphur.

Norway

Under the provisions of a recently concluded Trade Agreement with Finland, covering the period 1st December, 1953 to 30th November, 1954, Norway will supply 10,000 tons of sulphur. Actual exports in preceding years were as follows:-

1951	- 19,459 metric tons
1952	- 17,853 metric tons
1953 (January to October)	- 19,057 metric tons

The average f.o.b. value of 1953 exports was equivalent to £26.15.0d. per metric ton.

Iraq

It was announced early in December that an agreement was about to be concluded between the Iraq Government and the Texas Gulf Sulphur Company, in respect of the exploration and exploitation of sulphur resources in Iraq north of the 33rd Parallel. Negotiations had been in progress for over two years, even before the Iraq Government had invited interested parties throughout the world to submit their proposals in April, 1953 (see Bulletin No. 1). The agreement, which is subject to ratification by the Iraq Government, would grant exploitation rights to Texas Gulf Sulphur Company for a period of fifty years. Profits resulting from any enterprise are

to be shared on a fifty-basis, the Company paying Iraq's share in dollars and, at the same time, the Company is to supply sulphur for internal requirements at reduced cost. Every five years, one quarter of the total concession area is to be handed back to the Government and, after twenty years, the Company will retain only 1,000 sq.km. It is believed that there are indications of the existence of a salt dome similar to those exploited by the Company in Texas and the Company's primary interest is concerned with this possibility.

The concession is limited to "deep-seated" sources of sulphur only and, in this connection, it might be mentioned that plans for the construction of a fertiliser plant near Kirkuk are awaiting approval of the Iraq Development Board. For this purpose, local natural sour gas resources would be used and their employment would necessitate sulphur elimination. Its recovery may result in the arising of about 80,000 t.p.a. sulphur.

Mexico - New Production

The President of the Mexican Gulf Sulphur Company, Mr. Paul Nachtman, announced on 9th December that production had started at their San Cristobal Dome in the State of Vera Cruz, Mexico. It was reported at the same time that two further wells were being steamed. It will be recalled that production capacity of this Dome is rated at 200,000 tons of sulphur per annum.

Mexico - Gulf Sulphur Corporation

According to information supplied by this Company, the capacity of their Frasch sulphur project on the Chapas River at La Salinas is to be 400,000 tons and not 250,000 tons as mentioned in Bulletin No. 2. The erection of the plant is to be undertaken by Blaw-Knox, who indicated that the plant could be completed within one year after the financing had been arranged.

Early in November, the Gulf Sulphur Corporation filed a registration statement with the United States Securities and Exchange Commission seeking

registration of 700,000 shares of convertible preferred and participating stock at US. cents 10 par which are to be offered for public sale "as a speculation" at $10 per share. It is reported that Peter Morgan & Co., the underwriters, have agreed to offer the stock on a best efforts basis and will receive $1.50 per share selling commission. Given a satisfactory response to the above, it is probable that the plant will be completed early in 1955. Thirty test wells have been drilled and the proved reserves have been calculated at over 11 million tons of sulphur suitable for extraction by the Frasch process.

Mexican Rock Sulphur

According to recent reports, the Texas International Sulphur Company of Houston is planning to erect a plant to extract sulphur from crude ore near San Felipe, California. The plant is to be based on the autoclave process and will process sulphur rock from the Navarro concessions, which the Company is reported to have acquired recently. It was previously reported in Bulletin No. 2 that the American Sulphur and Refining Company was engaged on similar plans in this area, but it has not yet been established to what extent the two projects overlap. According to the President of the Texas International Sulphur Company, Mr. Victor Dykes, commercially, crude sulphur is to be produced at a price which would be competitive with American Frasch sulphur delivered to west coast consumers. In view of its location, it is unlikely to be of interest to European, notably United Kingdom consumers, but, given realisation of forecasts, Australian and New Zealand sulphur users may have available alternative sources of sulphur supply.

Colombia

The anticipated increase of sulphur production by Industrias Purace, S.A., on their installing a Chemical Construction Company flotation plant of 12,000 t.p.a. capacity has not materialised due to technical difficulties having been encountered. The Company continues producing sulphur by steam autoclaves, augmented by some output from the new

which

Chemical Construction Company plant, has resulted in about 4,000 tons being produced in 1953. The entire output is consumed in Colombia as follows:-

By rayon	-	2,400 tons
By sulphuric acid	-	600 - 1,200 tons
By sundry industries	-	600 tons

With the exception of some fine ground sulphur for special uses, there are no sulphur imports, the home producer being protected by high import duties.

Chile

Early in December, 1953, a Trade Agreement was concluded between Western Germany and Chile which provides, amongst others, for the export during 1954, of Chilean sulphur. It is reported that the recently concluded sale of 10,000 tons of sulphur was arranged under its terms at an export price in the region of £10.10.0d. to £12.0.0 per metric ton f.o.b. The transaction is to be controlled by I.N.A.C.O., the price having been modified by an internal compensation arrangement, in this case involving German machinery and manufactured goods which, as mentioned earlier, is now favoured by the Chilean Government.

Chile Sulphur Freights

During the past four weeks, the Pacific Freight Conference has made significant reductions in sulphur freights from Chile to the United Kingdom and the Continent. Pressure to abandon the earlier liner freight for bulk and bagged parcels of 133/- per metric ton, came primarily from British shipping interests, whose view that, as a relatively cheap commodity, sulphur was unable to sustain a high transport cost, prevailed after lengthy discussions. In early December, the freight of sulphur shipped in bulk was reduced to 81/- and, for bagged parcels, to 75/-. On 22nd December, it was announced that this anomalous difference had been removed and a uniform freight established at 75/- for sulphur shipped in bulk or bags.

STATISTICAL APPENDIX

AUSTRALIA

PRODUCTION (Thousands Tons Recoverable Sulphur*)

	In Pyrites	In Zinc Concentrates	Total
Average 1941/46	41.4	77.5e	118.9
1947	55.3	74.5	129.8
1948	41.6	81.7	123.3
1949	40.4	100.0	140.4
1950	50.9	107.9	158.8
1951	71.6	99.9	171.5
1952	93.6	105.8	199.4

e = estimate
* = Based on 90% Recovery in the case of sulphur in zinc concentrates and 91.5% in the case of pyrites.

EXPORTS - IMPORTS (Thousands Tons Sulphur)

	EXPORTS		IMPORTS
	In Zinc Concentrates	In Pyrites	Brimstone
Average 1941/46	44e	-	60e
1947	41e	-	110.6
1948	41.1	-	144.1
1949	40.5	+	144.0
1950	47.5	+	191.8
1951	42.5	3	99.4
1952	60.1	n.d.	111.4

e = estimate
+ less than 100 tons
n.d. - no data

U.S.A. - BY-PRODUCT SULPHURIC ACID PRODUCTION (Thousands Short Tons)

	Copper Plants*	Zinc Plants‡	Total
1948	112.0	529.4	641.4
1949	96.3	477.0	573.3
1950	131.3	609.6	740.9
1951	189.1	636.0	825.1
1952	202.4	664.7	867.1

* Includes acid produced at a lead smelter
‡ At some plants by-product acid production is augmented by the use of brimstone, yielding annually about 250,000 tons acid

JAPAN - SULPHUR (Metric Tons)

	Production	Exports[1]	Consumption[*]
1925	47,828	4,118	43,710
1926	47,946	4,078	43,868
1927	61,383	3,857	57,526
1928	70,230	5,322	64,908
1929	62,041	10,442	51,599
1930	61,575	5,916	55,659
1931	62,425	14,183	48,242
1932	84,424	25,998	58,426
1933	116,838	32,115	84,723
1934	139,823	45,710	94,113
1935	167,906	54,605	113,301
1936	203,456	71,870	131,586
1937	229,905	55,845	174,060
1938	226,611	31,241	195,370
1939	199,615	27,941	171,674
1940	191,330	17,292	174,038
1941	196,864	16,701	122,583
1942	168,193	18,348	163,926
1943	152,240	17,459	156,499
1944	76,548	7,255	91,098
1945	41,032	3,591	37,441
1946	22,145	2,530	19,615
1947	29,130	2,000	27,130
1948	40,605	600	45,091
1949	62,481	20	61,407
1950	92,623	511	93,034
1951	142,430	0	140,352
1952	179,486	42,696	135,612

[1] Outside the Japanese Empire

[*] Apparent - 1925 - 1940
Actual - 1941 - 1952